ACCIDENT

Aircraft Type and Registration:	Alpi (Cavaciuti) Pioneer 400, G-CGVO
No & Type of Engines:	1 Rotax 914F piston engine
Year of Manufacture:	2011
Date & Time (UTC):	3 January 2015 at 1528 hrs
Location:	Near Popham Airfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Fatal) Passengers - 2 (1 Fatal) (1 Serious)
Nature of Damage:	Destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	201 hours (of which 5 were on type) Last 90 days - 7 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft departed Bembridge Airfield, Isle of Wight for a VFR flight to Bidford Airfield, near Evesham. However, occasional low cloud and poor visibility may have precluded flight that was clear of cloud and in sight of the surface at all times. The aircraft approached Popham Airfield and manoeuvred as if preparing to land, before continuing in what appeared to be a low level, left-hand circuit. Whilst in the circuit, the aircraft stalled and struck trees before hitting the ground. Two of the occupants died at the scene, a third passenger survived with serious injuries. A defect was identified with the engine turbo (turbocharger) control, which likely resulted in the engine manifold air pressure limit being exceeded and the engine seizing in flight. Four Safety Recommendations are made.

Background

On 2 January 2015 the pilot flew the aircraft for approximately 50 minutes, from Bidford, near Evesham to Bembridge on the Isle of Wight. An adult passenger occupied one of the two rear seats and a young child was a passenger in the front right seat. The VFR flight was made in good weather conditions and passed over three areas where the terrain rose to approximately 800 ft amsl and close to two tall masts, the highest of which was seven miles north of Popham and is recorded as a 1,225 ft amsl obstruction.

The pilot planned the flight using navigation software and his flight log stated that there were 80 litres of fuel on-board, giving an estimated endurance of 3 hours 30 minutes. He flew close to the military airfield at Brize Norton before proceeding towards Popham. While transiting Brize Norton's airspace, the aircraft radio became stuck on transmit for several minutes. The pilot was unaware of this until he next spoke to ATC but the problem resolved itself when he terminated that call.

From a position just west of Popham, the pilot headed south-east, to keep clear of controlled airspace around Southampton Airport. After making radio contact with Solent Radar he was offered a more direct route and transited the eastern edge of the Southampton Control Zone. A recording of these exchanges indicated that the aircraft radio functioned normally and that the pilot used correct RTF procedures. However, he was told by ATC that the secondary radar indications from his transponder were "FLUCTUATING WILDLY" and did not show the aircraft at 2,400 ft amsl, as reported. The pilot remarked that the transponder was "BRAND NEW" and at the request of ATC he turned off the altitude encoding function (Mode C). He stated that he would have the system checked on the ground.

The flight continued south and crossed the Solent (the strait between the English mainland and the Isle of Wight) before landing at Bembridge. The airfield was unmanned and the aircraft parked there overnight. The pilot and his passengers travelled the nine miles to Cowes to spend an evening with friends.

History of the flight

On the morning of 3 January 2015 the pilot and his passengers met with their friends again and remained in their company until departing for the return flight to Bidford that afternoon. The weather in Cowes was overcast and misty and the pilot indicated that this might preclude the flight so provisional arrangements were made to stay a second night if necessary. The forecast for the following day was also poor and the only known reason to return home was to attend a social function.

Later in the morning the pilot noted sufficient improvement in the weather to express some optimism for a flight later that day. He was observed using his smartphone and tablet computer to evaluate the weather, but the friends were not conversant with aviation procedures and he did not discuss the details with them. At approximately 1400 hrs he stated that the weather should be good enough for the flight and one of the friends drove him and his passengers to Bembridge.

The airfield was again unmanned and the pilot reportedly spent approximately 20 minutes preparing the aircraft prior to start-up. There was no indication that any fuel was uplifted at Bembridge and a friend used a mobile phone to take a short video recording as the aircraft taxied to the runway. It was seen to backtrack the runway before the engine sound increased. A second video recording was made at approximately 1500 hrs as the aircraft took off and was lost from sight in misty conditions.

The aircraft's departure was also witnessed by a retired military aviator who was on a hill approximately 0.6 nm south of the Runway 30 threshold. His attention was drawn to the aircraft when he heard the engine being run at high speed. He spotted the stationary aircraft near the threshold and stated that the engine remained at high rpm for approximately one minute. Shortly after this the witness watched the aircraft take off and depart on a northerly track. The aircraft appeared to remain clear of cloud, but he lost sight of it due to poor visibility when it was approximately two miles north of his position. He estimated that the cloud base was probably not higher than 1,000 ft agl and he noted that approximately 30 minutes later it began to rain and the cloud base and visibility reduced to an estimated 300 ft agl and half a mile respectively.

No route plan or flight documentation for the return flight was found and it is presumed that this information was held on the pilot's badly damaged tablet computer (see *Recorded flight data*). Recorded radar evidence suggests that the pilot was backtracking the route that he had flown the previous day, keeping clear of controlled airspace around Southampton and remaining in Class G airspace. The route between Bembridge and Popham traverses ground with an elevation of 400-600 ft amsl but there are spot heights above this within two nautical miles of track.

No evidence was found to indicate that any radio transmissions were made from the aircraft during the flight and there were no reports of it being seen after departure from Bembridge, until it reached the vicinity of Popham. The poor weather had discouraged any other general aviation activity at Popham and airfields nearby that day.

Several witnesses saw the aircraft overfly Popham and turn on what appeared to be a left-hand circuit before it was lost from view. The radio operator at Popham alerted the police at 1528:34 hrs, as he was concerned for the aircraft's safety after it disappeared from view. The front seat passenger later stated that at some point he was told to brace for impact but was unable to recall any other significant evidence concerning the accident flight.

An air ambulance helicopter was already airborne in the vicinity and it quickly located the wreckage of the aircraft in woodland about ¼ nm southeast of the airfield. It landed in a field nearby at 1541 hrs and two paramedics proceeded to the aircraft and found the fuselage inverted. There were signs of life inside but they had to wait for the fire service to arrive and the aircraft to be lifted before they could free the occupants. At 1635 hrs the passenger was rescued from the front right seat with serious injuries. However, the pilot and the rear seat passenger had received fatal injuries as a result of the impact.

Witness accounts

At approximately 1525 hrs a motorist who was driving west on the A303 road (Figure 1), briefly observed the aircraft heading towards the airfield at low level. He believed it to be north of the road and presumed it was approaching to land on the westerly runway (Runway 26).

Two pilots at the airfield heard the sound of an engine, and one of them stated that it sounded as if an aircraft was executing a go-around. They then spotted G-CGVO just to the east; it appeared to be flying level and to make a "gentle left turn" as it passed over the airfield. Another pilot, also standing outside, saw the aircraft above the clubhouse. He thought it was tracking west and was "straight and level" at a speed which he estimated as 50-60 kt. He had the impression that the aircraft was not using full power.

In the clubhouse, several people heard the sound of an engine and looked out to see an aircraft heading in a west-south-westerly direction. Opinions about the aircraft's height varied from 150 ft to 400 ft agl but all the witnesses thought it was just below the base of the cloud and its description matched that of the accident aircraft. One person in the clubhouse, who was a pilot and also a qualified technician on Rotax engines, later remarked that the engine sounded as if it had a problem. He thought the aircraft was climbing slightly when he saw it. The recollection of other witnesses, who were also pilots, was that the engine sounded steady and did not appear to be rough-running.

Some witnesses left the clubhouse to watch the aircraft while the air/ground radio operator tried unsuccessfully to make contact on Popham's frequency. When the aircraft was close to the western airfield boundary, near the Runway 08 threshold, it was seen to turn south and to cross the A303 road. The motorist, who was still approaching from the east, caught sight of it again as it turned. Another witness, a private pilot and former air traffic controller, thought the aircraft crossed the A303 at an estimated 70-80 kt and 200 ft agl, before turning to parallel the road on an easterly heading. He stated it appeared to be on a left base for Runway 03 but to be "too low". This witness was therefore surprised when the engine seemed to throttle back and become quieter while the aircraft descended gently. Other witnesses also saw the aircraft descending and to pass through the extended centreline of Runway 03 tracking east, until it was hidden from view by trees.

The motorist slowed down and watched the aircraft for short intervals as he passed the southern airfield boundary. After the aircraft turned east he observed it, with wheels down, flying level and seemingly under control above the trees, but "not very high". The next time he saw it, the aircraft was almost due south of his position and he realised "it was descending rapidly in a flat attitude". The wings were "wobbling" (rolling), it was "turning on its own axis" (yawing), and the nose went "down and then up" but it did not seem to climb. When the motorist glanced back again he could not see any sign of the aircraft. He suspected it had crashed and he later phoned the emergency services.

Accident site and wreckage

The aircraft came to rest in woodland approximately 350 m south of the service station on the westbound carriageway of the A303. The initial contact point of the aircraft was identified by damage marks on a large tree approximately 60 ft above the ground, with material from the aircraft wing retained in the branches. Roughly half the right wing had detached from the aircraft and was scattered between the base of this tree and the location of the main fuselage 40 m away on a bearing of 080º. A second tree adjacent to the main wreckage also exhibited a number of damage marks approximately 10 ft above the ground, with sections of the left wingtip scattered a few metres away from its base.

The main fuselage lay inverted, with the tail section detached at a point just aft of the rear seat and baggage section. The cabin roof, windscreen and doors were detached. The nose section forward of the front seats was also largely detached, with the engine only retained by peripheral wiring and hoses. The turbo wastegate was found in the fully closed position. One of the propeller blades had detached from the hub at the root, but was located directly under the engine. Both blades were in good condition with no impact marks on the tip or leading edges. The fuel tank selector was set to the right tank and the ignition key was selected to both ignition systems. The landing gear was down and locked, which was consistent with the gear selection lever position. Only one flap remained attached to the wing and was in the fully up position; it was not possible to verify the selected position. Both wing fuel tanks contained some residual fuel, but had been damaged during the impact. Statements provided by the emergency service responders confirmed that fuel had been steadily leaking from the tanks when they first arrived on scene.

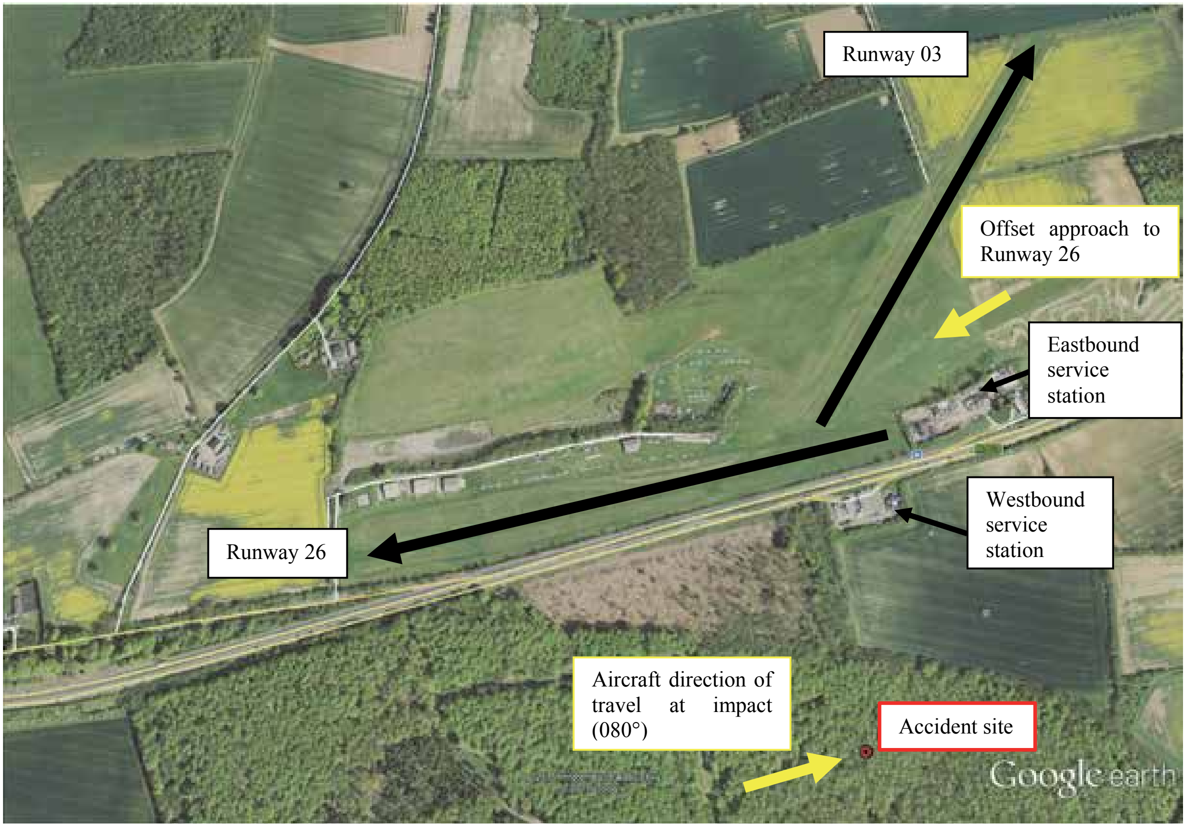

Figure 1

Popham Airfield and accident site

Popham Airfield

The A303 runs parallel to Popham Airfield boundary and there is a prominent road service station located on a rise in the ground on the northside of the road just before the threshold of Runway 26. The promulgated approach to Runway 26 involves an offset final approach to avoid the need for a steep descent on late finals and to keep aircraft clear of the service station. A large white arrow is marked on the ground to highlight this. Circuits are normally flown to the north of the airfield at standard circuit height of 800 ft.

Meteorological information

Three emergency services helicopters attended the site soon after the accident. The pilots of all three helicopters estimated the lowest cloud to be at approximately 400 ft above the accident site when they arrived. They reported that conditions further east gave patchy cloud extending to the ground in some places. The coastguard pilot recalled that on departing Lee-on-Solent Airfield (close to G-CGVO's track) at 1510 hrs, the lowest cloud had a base of approximately 800 ft agl and estimated the visibility to be 5,000 m. Approximately 40 minutes later, when flying inland towards the accident site, from the southeast, visibility had deteriorated to an estimated 2,000 m in places.

The UK Met Office reported that a series of fronts, associated with a centre of low pressure, passed over southern England on the afternoon of 3 January 2015. The aircraft was likely to have encountered a band of rain associated with an occluded front soon after crossing the coast near Portsmouth. South of the front there was a strong westerly airflow but this turned northerly and the temperature dropped by approximately 6ºC north of the front. The air was saturated on either side of the front and there was little difference between the reported temperatures and the dew points. The lowest reported cloud was likely to have caused hill fog to form over higher ground north of Portsmouth.

Weather information was not recorded at Popham but the witnesses there estimated that, when they saw the aircraft, wind direction was somewhere between 360º and 045º with a strength of between 6 and 12 kt. It was misty and the consensus of opinion was that visibility was approximately 3,000 m while the cloudbase was approximately 300 ft agl. This information accorded with the Met Office's analysis.

The Met Office aftercast agreed with the forecast chart (F215) for weather below 10,000 ft between 0800 hrs and 1700 hrs. It was issued at 0300 hrs on 3 January 2015 and indicated the expected positions of the fronts at 1200 hrs (Figure 2).

Study of this chart shows that the origin of the flight was within area D and that the aircraft would have had to fly through the occluded front (depicted in magenta). The forecast for the area was for scattered or broken stratus cloud with a base at 400-1,000 ft amsl and tops at 1,500 ft amsl. Above this a broken or overcast layer of cumulus and strato-cumulus extended up from 1,500-3,000 ft amsl with tops at 6,000-8,000 ft amsl. Visibility was forecast to reduce to 6,000 m in rain and drizzle but in isolated places it was forecast to reduce to 3,000 m or to 1,200 m near the coast. The freezing level was forecast to be no lower than 2,000 ft amsl to the north of the occluded front; measurements taken at Gatwick Airport, after the front had passed there, indicated the freezing level was above 4,000 ft amsl.

Before deciding to proceed with the flight, the pilot may have studied the forecast weather for airports near his route along with weather reports (METARs) issued at 1350 hrs. Among the airports he could have considered were, Southampton (44 ft amsl and approximately 10 nm west of the aircraft's route), Odiham (405 ft amsl and 11 nm east-northeast of Popham (550 ft amsl)) and Brize Norton (288 ft amsl). The relevant information which these airports provided was:

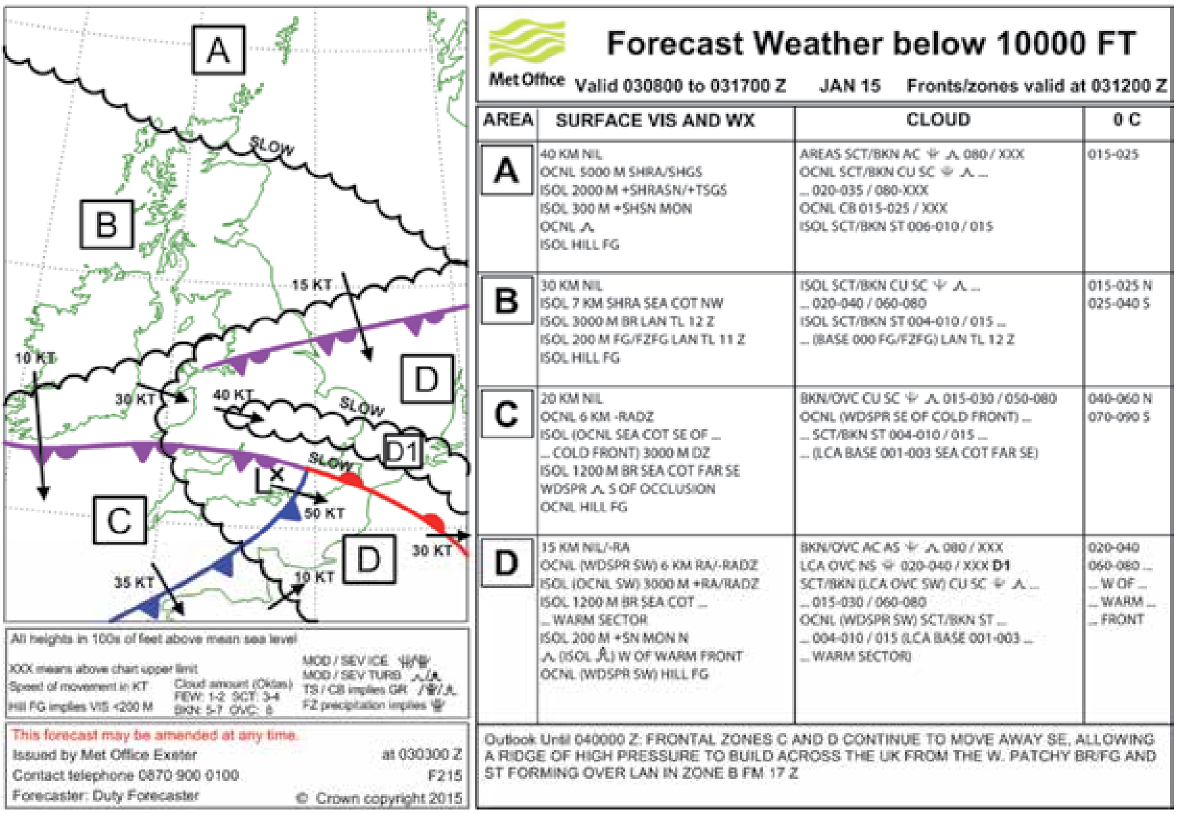

Figure 2

Forecast weather below 10,000ft (F215)

Southampton

- 1350 hrs: Wind, mean direction, from 290º at 12 kt gusting to 22 kt, visibility 8 km but reducing to 4,000 m to the north of the airfield, rain, scattered cloud 1,200 ft agl, broken cloud 2,300 ft agl, temperature 12ºC and dew point 10ºC.
- 1403 hrs: The forecast for the period between 1500 and 1800 hrs was for the wind to veer to be 020º at 7 kt, visibility to decrease temporarily to 7,000 m in rain with broken cloud at 1,000 ft agl
- 1450 hrs: Wind, mean direction, from 290º at 12 kt, visibility 6 km, rain, scattered cloud 1,200 ft agl, broken cloud 1,600 ft agl, temperature 12ºC and dew point 11ºC.
- 1520 hrs: Wind, mean direction, from 340º at 15 kt, visibility greater than 10 km, showers in the vicinity, scattered cloud 800 ft agl, broken cloud 1,300 ft agl, temperature 9ºC and dew point 7ºC.

Odiham

- 1350 hrs: Wind from 270º at 16 kt, visibility greater than 10 km, broken cloud at 800 ft, overcast cloud at 1,500 ft, temperature 11ºC and dew point 9ºC.
- 1450 hrs: Wind from 330º at 15 kt, visibility greater than 10 km, broken cloud at 400 ft agl, overcast cloud at 1,600 ft agl, temperature 6ºC and dew point 5ºC.
- 1550 hrs: Wind from 360º at 12 kt, visibility greater than 10 km, cloud overcast at 400 ft agl, temperature 5ºC and dew point 4ºC.

Brize Norton

- 1350 hrs: Wind from 020º at 9 kt, visibility 6 km, rain, scattered cloud at 600 ft agl, broken cloud at 1,200 ft agl, temperature 5ºC and dew point 4ºC. A temporary deterioration in visibility to 4,000 m with scattered cloud at 400 ft agl was also reported, while the forecast was for broken cloud at 800 ft agl and temporarily, between 1500 and 1800 hrs, the visibility was expected to fall to 3,000 m in rain and drizzle, with broken cloud at 400 ft agl.

The airfields which issued forecasts and were closest to Bidford, the aircraft's destination, were Birmingham (about 20 nm to the north) and Gloucester (about 20 nm south-southwest). Both airfields reported cloud cover below 500 ft agl at 1350 hrs but the forecasts for two hours later, when the aircraft should have arrived at Bidford, were for visibility to be greater than 10 km with no cloud cover expected below 1,200 ft agl.

Private pilots' weather awareness

Private pilots under training have to demonstrate a good understanding of meteorological conditions and how to obtain and interpret weather forecasts. The UK CAA also publishes Safety Sense Leaflet 1e *'Good Airmanship'*[1]. This states that continued flight into bad weather is one of the main causes of fatal accidents in the UK and offers the following advice:

> *'Get an aviation weather forecast, heed what it says and make a carefully reasoned GO/NO-GO decision. Do not let 'Get-there/home-itis' affect your judgement and do not worry about 'disappointing' your passenger(s)…'*

The leaflet mentions a booklet produced by the UK Met Office, titled *Get Met*[2] as a reference for the various methods of obtaining aviation actual and forecast weather and for the codes used in them.

Footnote

1 The UK CAA produces Safety Sense leaflets to promote safe practices to UK pilots. They can be downloaded from the CAA website www.caa.co.uk. Similar, complimentary material is published by the European General Aviation Safety Team at www.easa.europa.eu/essi/egast/

2 (see www.metoffice.gov.uk/aviation/ga)

Pilot information

The pilot gained a PPL in 2008 and added an IMC rating in 2010. Most of his experience was gained on Piper PA-28 Cherokees and on 17 August 2012 his Single Engine Piston (SEP) Class rating was revalidated by way of a licensing skill test on this type. The pilot had not flown for seven weeks prior to that date but the examiner recalled that he "had no worries about him". The examiner's opinion was that the pilot was a level-headed, competent and steady PPL holder, who demonstrated good airmanship and had no handling issues during this flight or during renewal of his IMC rating during February 2013.

An EU Part-FCL PPL was issued to the pilot in July 2013 and in August 2014 his SEP Class rating was revalidated to 13 August 2016, on the basis of his flying experience over the preceding 24 months. Also in August 2014 he gained a FAA Private Pilot certificate, while two months earlier he had commenced helicopter lessons. His total recorded flying experience included 14 hours helicopter flying, with the last such flight taking place on 5 December 2014.

The accident aircraft was acquired by the pilot in October 2014, as a replacement for the smaller two seat version of this type, which he had owned since July 2013. Both aircraft had retractable undercarriage and a variable pitch propeller but, unlike his previous aircraft, the engine in the accident aircraft was turbocharged.

EU Part-FCL requires differences training to be completed when pilots first fly aircraft with certain systems (see *Differences training*). This training has to be provided by an instructor who is required to annotate the pilot's logbook on completion. No relevant training was recorded in the pilot's logbook to reflect that this requirement had been met. The log book recorded that he had accumulated 35 hours as pilot-in-command on the previous aircraft until October 2014. The person who imported the aircraft into the UK was an experienced pilot on both types. Although not a qualified instructor, he assisted the pilot in becoming familiar with both aircraft. This individual recalled that prior to starting familiarisation training[3] on G-CGVO, the pilot had stated that he had received the necessary differences training.

The pilot recorded a little less than three hours experience in the aircraft during October 2014 and then made a further flight lasting 50 min on 6 December 2014. There was no evidence that he carried out any further flying, in this or in any other aircraft, until 2 January 2015.

Medical and pathology

The pilot held a Class 2 Medical Certificate with an expiry date of 18 October 2015 which required him to have corrective spectacles for near vision. Several pairs of such spectacles were found at the accident site.

Post-mortem examinations were conducted on the pilot and the rear-seat passenger by a specialist aviation pathologist. He stated that both '*died of injuries which were sustained at*

Footnote

[3] Familiarisation training does not necessitate the involvement of an instructor and there is no requirement to record it. (See *Differences training*).

the time G-CGVO crashed in woodland'. Toxicology tests indicated levels of over-the-counter pain killers in the pilot's body that were consistent with therapeutic use. The reason for taking them was uncertain but the pathologist stated he had '*no reason to believe that medical factors played any role in the causation of the accident*'.

Aircraft description

Although designed as a Permit-to-Fly, self-build kit aircraft, because it was the first of the type to be imported to the UK, G-CGVO was built by the original owner whilst being supervised by the manufacturer at their facility in Italy. It was subsequently used as a flight test aircraft to enable type acceptance by the Light Aircraft Association (LAA).

The Pioneer 400 is a low-wing, lightweight, wood and composite design for general aviation use. It has a retractable tricycle undercarriage and electrically actuated flaps. The engine is connected to a two-blade constant-speed propeller controlled by a hydraulic governor, via a gearbox with a slip clutch to prevent shock-loading. The 400 model is a derivative product introduced to add a rear seat, increasing the number of passengers to three compared to the original 300 model design which only had two front seats.

G-CGVO was a 400T variant fitted with a turbocharged engine to increase the maximum power available. The turbo primarily operates during takeoff, when the throttle is advanced beyond the 100% maximum continuous setting to a 115% takeoff setting. This increases the engine power (ISA) from 73.5kW (98.5 hp) to 84.5 kW (113.3 hp). This power increase is achieved by intake air being compressed as it passes through the turbo, increasing the air pressure and thus air mass entering the intake manifold for the engine. An impellor in the turbo is connected to a turbine driven by the exhaust gas from the engine. A spring-loaded wastegate opens and closes under the action of a servo motor, to increase or reduce the amount of exhaust air passing through the turbine. This in turn controls the speed of the impellor and thus the air pressure within the intake manifold.

The wastegate servo motor is controlled by a Turbo Control Unit (TCU). This receives input from sensors on the engine and an ambient air pressure sensor, to achieve a target manifold pressure and thus engine speed for a given throttle position through different altitudes. It provides electrical power to the servo to move the turbo wastegate, based on feedback from the manifold air pressure sensor. The engine manual recommends that the throttle should be moved directly from 100% to 115% when required, as fine control of the turbo is not practical between these throttle positions. The TCU then controls the servo to maintain the manifold pressure at the target figure. It also has protection logic to prevent the engine from overspeeding.

The published manifold pressure limit at takeoff power is 1,350 hPa (39.9 in Hg), with a nominal maximum engine rpm of 5,800. The engine is limited to five minutes continuous time at this power. If the TCU senses an exceedence beyond 5,900 rpm, it will reduce the target manifold pressure, thus controlling the servo to open the wastegate further. The manufacturer advised that exceedences below 1,550 hPa or 6,200 rpm should be reported to the maintenance provider for assessment but, for exceedences above these figures, rapid catastrophic damage is likely. The manufacturer advised that service information for the engine indicated that a manifold pressure of 2,200 hPa or more could overcome the interference fit of the sections of the crankshaft causing a misalignment.

The TCU is wired to red and orange warning lights fitted on the top left side of the instrument panel. If a wiring or sensor defect is identified by the TCU, a flashing orange warning is triggered. If the five-minute time limit at takeoff power is exceeded, the red warning light will flash until the manifold pressure is reduced. If an engine manifold pressure of 1,550 hPa is exceeded a continuous red warning is triggered, until the pressure is reduced below the limit threshold. The TCU has a small amount of internal memory. It records, at one minute intervals, the maximum readings that occurred during the previous minute for a number of sensors. The recording covers the last 20 minutes of operation before the oldest data is overwritten. It also records alerts for parameter exceedences for the life of the engine, with the last 100 alerts retained in the memory. The 12 Vdc power supply for the TCU is wired to a thermal circuit breaker positioned next to the warning lights on the instrument panel. The installation manual states that an electrical power isolation switch should be installed for the wastegate servo motor. On the accident aircraft pulling the TCU circuit breaker was the only means of isolating the motor.

The aircraft instrument panel was equipped with a small Engine Information System (EIS) display (Figure 3). This was a user-configurable display that provided information such as flight time, fuel flow, exhaust gas temperature and other relevant parameters relating to the engine. It provided the only display of engine manifold pressure, which was sensed directly by the EIS from an air pressure tapping on the manifold[4]. The EIS also displayed engine rpm, which was an electronic tacho signal generated by a magnet on the engine flywheel passing a coil. The signal was fed to the EIS via the TCU. The rpm display could be configured so that it changed to yellow, then red as it passed trigger thresholds set by the user. In the case of G-CGVO these were set at 5,770 and 5,800 rpm respectively. The manifold pressure display did not have any form of limit exceedence warning. The rpm signal was also supplied from the EIS to a traditional rpm dial gauge on the aircraft instrument panel.

Figure 3

EIS on test bench showing rpm and manifold pressure display

Footnote

4 The TCU was connected to its own air pressure tapping but on the same manifold as the EIS.

Recorded data

The aircraft was not fitted with a flight recorder but information was recovered from a GPS unit, the EIS, the TCU, the radio navigation and communication system and the transponder. Two tablets and a smartphone were also recovered from the accident site but were too damaged to yield any data. Sources of data external to the aircraft included radar recordings, and video recordings of the start of the flight. Recorded radio transmissions were also reviewed and relevant content is provided in the history of the flight section.

GPS

The GPS unit was a FlymapL, set up to record flight paths. Normally, flight track data is stored in volatile memory[5] until an end-of-flight condition is met, at which point the flight information is transferred to non-volatile memory[6]. The accident flight did not trigger the end-of-flight actions and thus did not transfer the data to the non-volatile memory prior to loss of electrical power. Whilst data was successfully downloaded for previous flights, no data could be recovered for the accident flight.

Turbo control unit

The 20 minutes of TCU data was successfully downloaded, but was found to be consistent with the start of the flight, not the end of the flight; 42 alerts were also downloaded. The TCU stops recording data either due to the loss of an rpm signal or loss of the 12 Vdc power supply. There is no way of knowing from the data which occurred. Notwithstanding the premature end of the recording, no anomalies with the 20 minutes of data were identified.

One of the parameters that the TCU records is cockpit ambient air pressure; the sensor was recovered from the wreckage and calibrated. The effects of airspeed on ambient cockpit pressure were measured on a similar aircraft. The recorded maximum ambient pressures were then converted into minimum altitudes. Boost time is recorded as the period when the throttle is beyond 108% and reflects the time during which increased manifold air pressure from the compression provided by the turbo results in a higher engine power output. The data is shown in Figure 4.

TCU alert log

The TCU records alerts triggered by engine parameter exceedences. All 42 recorded alerts had been triggered by a manifold pressure that exceeded the 1,350 hPa threshold. The level of exceedence varied but was mostly within the 1,400 – 1,500 hPa range, with the maximum pressure recorded as 1,542 hPa. The TCU does not provide a warning to the pilot for exceedences below 1,550 hPa. The exceedences all occurred with a throttle position above 100%, but the associated wastegate servo position was not always recorded as being 100% (fully closed). No reference to these exceedences was found in

Footnote

[5] Volatile memory requires a battery to maintain the memory. If power is lost, the data is lost.
[6] Non-volatile memory will retain data with or without power.

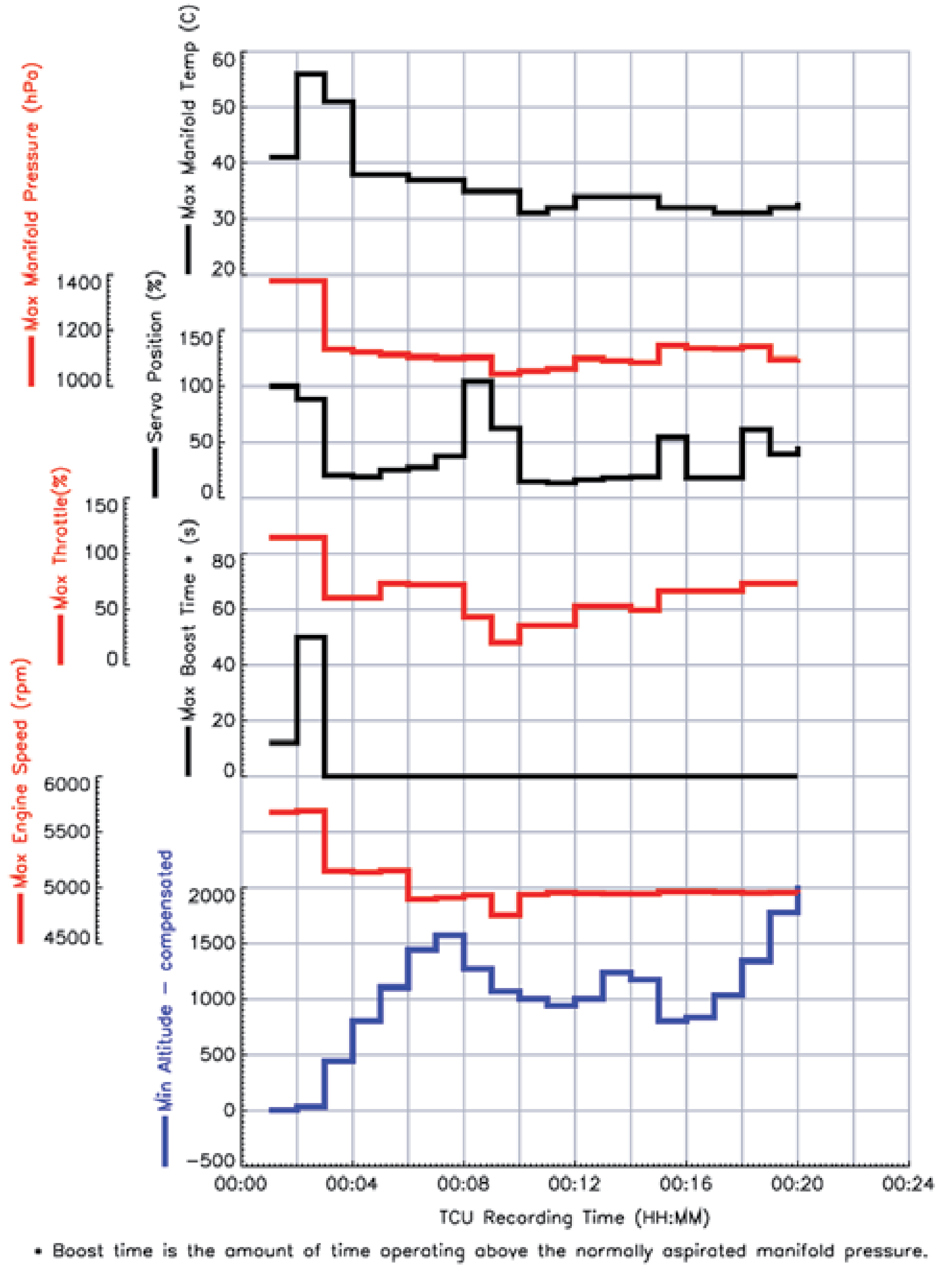

Figure 4

TCU download of the last 20 minutes of recorded operation

either the engine or aircraft log books. The manufacturer requires that such exceedences are recorded but unless the exceedences are observed whilst they are displayed on the MAP readout on the EIS screen, the pilot may be unaware they had occurred.

Engine indication system

The EIS was removed from the instrument panel. Though later models record more, this earlier model recorded only limited information. The unit showed a total engine operating time[7] of 200 hours and 42 minutes, of which 7 hours and 15 minutes was above the yellow threshold but none above the red threshold for rpm. The maximum engine speed recorded by the unit over all flights was 5,800 rpm.

The unit also records the duration of the last flight and the maximum engine speed during that flight. The flight timer was configured so that if the engine speed increased above 4,000 rpm for more than approximately 35 seconds, it would reset and start counting whole minutes until the engine stopped, freezing the flight time displayed. The unit recorded a flight time of zero hours and zero minutes and an engine speed of 4,890 rpm. The displayed data indicated that at some point the tacho signal input no longer reflected a running engine. An engine speed of more than 4,000 rpm was then sensed, with a valid tacho signal continuing for between 35 seconds and 90 seconds, with a maximum engine speed of 4,890 rpm. It could not be established whether this was the last of many cycles or a single event. It may also have been the result of a loss of wiring continuity in normal operation or as a consequence of the accident. These values would also have been preserved through subsequent periods of tacho activity provided that the engine speed remained less than 4,000 rpm or only exceeded 4,000 rpm for less than 35 seconds. Given the lack of time stamps, the limited recorded data could not be definitively related to the accident flight.

Takeoff video

The first recordings relating to the accident flight were videos taken by a witness at Bembridge Airport using a smartphone. These showed the aircraft taxiing and then taking off. The takeoff roll started at 1459:29 hrs.

Radar

The flight on the previous day was continuously visible to secondary radar. When the altitude reporting function was active, the reported altitudes were erratic compared to the altitudes recorded by the GPS.

Secondary radar recordings from Pease Pottage, Heathrow, Gatwick and Bovingdon, and primary radar recordings from Heathrow, Southampton and Farnborough, provided flight path information for the accident flight. The recorded tracks were intermittent compared to the previous flight with none of the sources capturing the manoeuvring in the vicinity of Popham at the end of the flight.

Footnote

[7] The total engine operating time reflects the total hours for the aircraft but this was accrued on two separate engines following replacement after an unrelated incident.

Transponder and navigation/communication units

The transponder was removed from the aircraft and powered. It showed a squawk of 0011 and indicated it was in standby mode.

The aircraft's navigation and communication radio system was also interrogated. The active and standby communications frequencies were 120.225 (Solent Approach) and 123.250 (Bembridge) respectively. The active and standby navigation frequencies were 117.45 and 116.40 respectively; neither were relevant to the accident flight. No logged faults were relevant to the investigation.

Amalgamated data

The pertinent recorded information is shown in Figure 5. The aircraft took off from Bembridge at 1500 hrs. The aircraft transponder was not reporting altitude but was initially squawking 7000 and then switched to the Solent listening squawk of 0011 whilst over the Solent, approximately 2 nm south of Gosport. The aircraft altitude reached approximately 1,600 ft amsl in the vicinity of Gosport after which the aircraft started to descend and the secondary radar track stopped.

The TCU data indicates that the aircraft flew between 1,300 ft amsl and 800 ft amsl for the next nine minutes. At 1519 hrs, the aircraft climbed through the line-of-sight limits of Heathrow and Farnborough primary radars, both at approximately 1,500 ft amsl in that location. The TCU stopped recording shortly after this, with a last minimum altitude value of 2,000 ft amsl.

The aircraft stayed above the radar line-of-sight limit of approximately 1,500 ft amsl for 5 minutes whilst tracking towards Popham. The subsequent loss of radar track by Heathrow and Farnborough primary radars indicates that the aircraft descended below 1,500 ft amsl approximately 2.2 nm south of Popham, and then below 900 ft amsl (about 600 ft agl) 1.4 nm south of Popham. There is no recorded information that relates to the flight path after this point.

No secondary radar returns were recorded for this aircraft after the initial track, despite the aircraft later being within line-of-sight of a number of secondary radar heads.

Differences training

Differences training for systems such as retractable undercarriage, variable pitch propellers and turbochargers is required in accordance with European Commission (EU) Regulation No 1178/2011 at FCL.710 and its associated Acceptable Means of Compliance (AMC) and Guidance Material (GM). UK AMC and GM can be found in CAA publication CAP 804 (Section 4, Part H, Subpart 1, paragraph 4.3). Holders of UK, JAR-FCL and National Private Pilot's Licences are also required to have this training; UK Air Navigation Order 2009, Schedule 7, Part B, Section 2 refers.

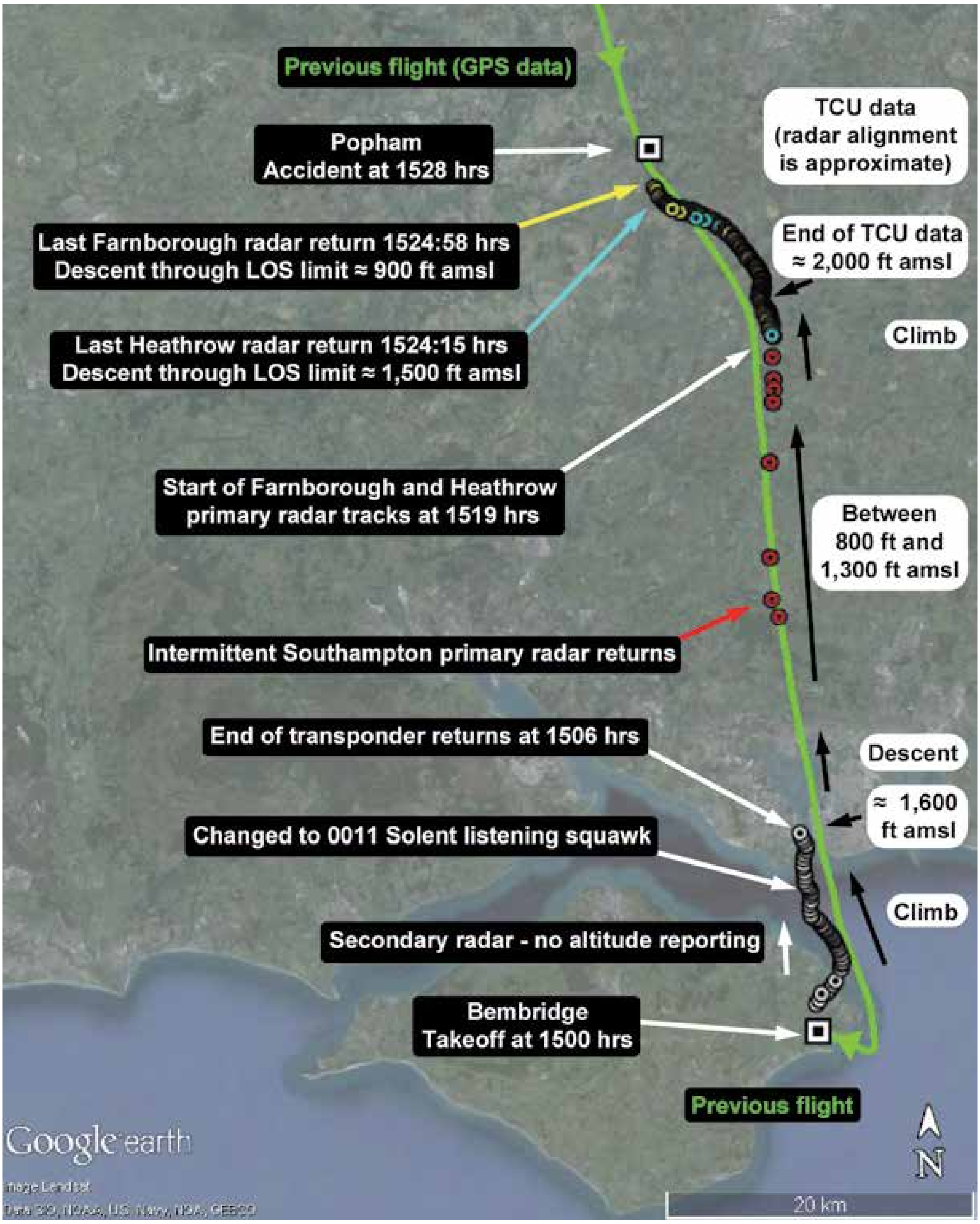

Figure 5

Amalgamated recorded data

Holders of EU pilot's licences containing an SEP Class rating are required to undertake differences training or familiarisation training prior to operating another '*variant of aircraft* within the SEP Class for the first time. There is no definition for a *'variant'* but differences and familiarisation training is defined by the GM to FCL.710 as:

> *'(a) Differences training requires the acquisition of additional knowledge and training on an appropriate training device or the aircraft.*
>
> *(b) Familiarisation training requires the acquisition of additional knowledge.'*

FCL.710 specifies that:

> *'The differences training shall be entered in the pilot's logbook or equivalent record and signed by the instructor as appropriate.'*

There is no requirement for familiarisation training to be recorded. Differences training within the SEP Class is only required when a pilot converts for the first time to a *'variant'* with a system such as a turbocharger or retractable undercarriage. Otherwise only familiarisation training is required and this, at its simplest level, can be achieved through self-study.

CAP 804 lays out the recommended scope of the differences training and one of the areas to be addressed is '*In-flight failures and emergency handling*'. The differences training that is undertaken will be appropriate to the specific aircraft the pilot is going to fly and, once such training is completed, it is valid for other '*variants*' in the SEP Class that incorporate such a system. Therefore, once turbocharger differences training has been completed on one *'variant'* within the SEP Class it is valid for any other '*variants*' in that Class with a turbocharger, no matter what technical difference may exist.

Local rules and resident instructors at flying clubs will tend to ensure pilots receive differences training and/or familiarisation training as appropriate before they fly a *'variant'* that is new to them. In other circumstances, pilots need to understand the requirements themselves. Without reference to CAP 804 or the Regulations, they might learn about differences training through study of the CAA's website or by reading the CAA Safety Sense Leaflet No 1e *'Good Airmanship'*. Alternatively this pilot, being a member of the Light Aircraft Association (LAA), might have been aware of its pilot coaching scheme which covers differences training. Details of this coaching scheme, which can provide pilots with tailored training before flying a *'variant'* that is new to them, are available on the LAA's website and in a leaflet which is distributed to new owners of light aircraft. Familiarisation training is not a requirement for pilots exercising the privileges of a UK national licence.

Applicable regulations

Pre-flight duties of the aircraft commander

The Air Navigation Order 2009 (ANO), which was applicable to the accident flight, listed the pre-flight duties of an aircraft commander at Article 86. It included the following;

> *'A commander must, before taking off on a private flight, an aerial work flight or a public transport flight, take all reasonable steps so as to be satisfied (that) … the flight can safely be made, taking into account the latest information available as to the route and aerodrome to be used, the weather reports and forecasts available and any alternative course of action which can be adopted in case the flight cannot be completed as planned.'*

Flight Rules

The Air Navigation Order 2009 (ANO), which was applicable to the accident flight, stated at Article 23 (5) that, without the prior permission of the CAA, an aircraft flying in accordance with a Permit-to-Fly might only be flown by day and in accordance with the Visual Flight Rules (VFR). This meant the pilot had to adhere to the Rules of the Air Regulations 2007[8] and Rule 28 (4) which required that an aircraft being flown outside controlled airspace at or below 3,000 ft amsl, with an indicated airspeed of 140 KIAS or below, to remain clear of cloud with the surface of the ground in sight, and with a minimum visibility of 1,500 m. For flight at a speed greater than 140 KIAS, the minimum visibility permissible was 5 km.

The pilot was also required to respect the Low Flying Rule (Rule 5). This stated that an aircraft should not be flown closer than 500 ft to any person, vessel, vehicle or structure and that it should not be flown below 1000 ft above the highest obstacle within a 600 m radius when over the congested area of a city, town or settlement. An aircraft is exempted from this rule while taking off or landing.

Evaluation flight

As part of the investigation the AAIB conducted an evaluation of a similar aircraft, with a similar weight and balance to the accident aircraft. This was flown by a qualified test pilot, who is also an EASA qualified flying instructor for SEP aircraft. The flights were carried out to gather data on the aircraft and its equipment and to assess the aircraft's handling characteristics in certain circumstances. The test pilot stated that it was a capable four-seat aircraft with a modest takeoff performance, but which achieved a good cruise speed. He observed a subtle pre-stall buffet and a benign stall with no tendency to drop a wing. In the normal landing configuration, with gear down and full flap, a stall warning was recorded at 41 KIAS and the aircraft stalled below 40 KIAS which was the minimum speed shown on the ASI.

Footnote

[8] After this accident, on 30 April 2015, the Rules of the Air Regulations 2007 were replaced by the Rules of the Air Regulations 2015 along with the Standardised European Rules of the Air Regulation (SERA).

The test pilot evaluated the aircraft's performance during a go-around with the gear down and full flap and assessed it as poor. At 57 KIAS and with a rate of descent of 200-500 ft min, application of full throttle did not immediately arrest the descent and only a very gentle rate of climb was achieved at 60 KIAS without changing the configuration.

In regard to the performance of the engine the test pilot stated that the response of the turbo was very gentle with no noticeable surge of power or difficulty in engine operation – it took approximately 3 seconds to go from cruise power of 32-34 in Hg Manifold Air Pressure (MAP) to 39-40 in Hg which indicated full takeoff power. The test pilot's evaluation concluded that, from a handling perspective, there were "no issues with engine operation that warranted additional training over and above operating a normally aspirated version of the engine."

Detailed wreckage examination

Once the wreckage had been returned to the AAIB HQ at Farnborough, the engine was stripped with the assistance of an engineer experienced on the type. It was noted that it was not possible to turn the crankshaft in the engine's 'as found' condition. The engine was then progressively disassembled. No findings of significance were identified during this process, other than the removal of these components had no effect on releasing the crankshaft. The engine crank case was then separated and the crankshaft was found to have twisted due to a torsional load. This distortion had caused the shaft to impinge on the engine crank case, such that it was seized in position.

A detailed inspection of the aircraft instrument panel and aircraft wiring was also carried out to identify any defects which may have resulted in the loss of power supply or tacho signal to the TCU. The power supply circuit breaker for the TCU was found in the open position, although several other circuit breakers close to it on the panel were still in the normal closed position. The wiring looms on the engine and behind the instrument panel had suffered damage during the accident sequence, but there was full continuity for the TCU rpm and power supply wiring. However, one of the wires from the throttle position sensor to the TCU was damaged approximately three centimetres from the sensor connector, in a manner that was not consistent with the other examples of impact damage. On closer inspection the inside of the wire's insulation was found to be coated with residue. Inspection of the wire under a microscope showed that the copper conducting wires had been worn flat, with the surface covered in microscopic striations oriented in slightly different directions. (Figure 6)

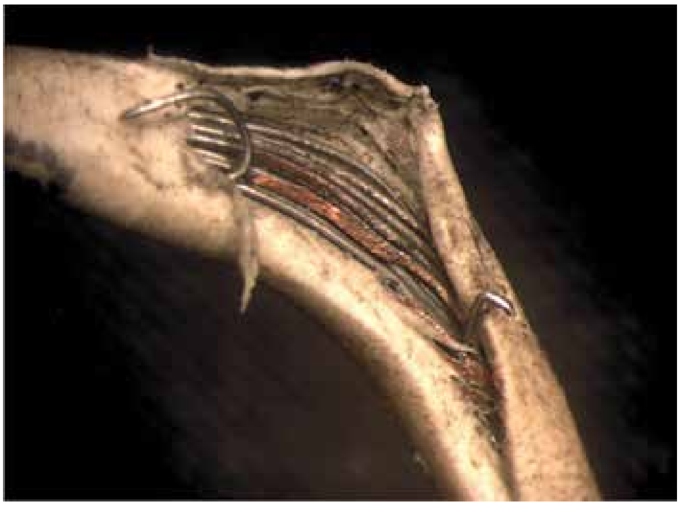

Figure 6

Magnified image of damaged throttle position sensor wire

TCU and EIS test loom

A test loom was created using a combination of original sensors and wiring from the aircraft and a digitally generated tacho signal to replicate the engine rpm input. The TCU was first tested to determine that it functioned as expected, driving the servo motor to the appropriate position as the rpm and MAP were varied, including the overspeed protection logic[9]. No anomalies were found and the EIS indicated the correct rpm figure.[10] The equivalent wire from the throttle position sensor that was found damaged on the aircraft, was then shorted to earth. This resulted in the orange warning light flashing and the servo motor being driven to the 100% position (nominally resulting in the wastegate being fully closed), and remaining there for as long as the wire was grounded. The power to the TCU was then isolated and the servo remained in the same position. This response was consistent with the manufacturer's Operator's Manual. Despite the TCU power being removed, the EIS continued to display an accurate rpm reading.

Engine manufacturer's Operator's Manual

The Operator's Manual for the engine states that in the event of an orange TCU warning being triggered, the pilot should:

> *'Reduce speed and boost pressure manually to be within the operating limits.'*

It also states:

> *'Limited flying operation, as this may indicate the boost control is no more or insufficiently possible and may affect engine performance.'*

There is also a statement which says:

> *'NOTICE: If the manually controlled variable is not possible, then turn off the servo motor.'*

Aircraft manufacturer's operating manual

There is no requirement, for a permit-to-fly aircraft, such as G-CGVO, to have an approved operating manual. However, the manufacturer provided an Aircraft Flight Manual for this aircraft including a limitations section and some checklists to deal with normal and emergency procedures. The powerplant limitations did not include the manifold air pressure limit for the engine and the emergency procedures did not address the illumination of either the orange or red TCU warning lights.

Footnote

[9] Only the servo function was tested. When fitted to the aircraft a calibration sequence is required to ensure the wastegate position matches the servo position. It was not possible to assess the calibration for G-CGVO due to the accident damage but the 20 minutes of recorded data is broadly consistent with a correctly calibrated system.

[10] The MAP pressure tapping on the EIS could not be used due to impact damage, so the accuracy of the MAP display could not be assessed.

Analysis

Weather

The meteorological information available before the aircraft left Bembridge was not conducive to a VFR flight to Bidford that backtracked the route flown south the previous day.

The 1350 hrs report for Odiham indicated broken cloud at 800 ft agl and, in order to backtrack the route flown southbound, the aircraft would have to pass over terrain where the elevation was 400 ft higher than that at Odiham. In addition, the forecast for Brize Norton indicated that the aircraft could encounter conditions of 3,000 m visibility with cloud at 400 ft agl in that vicinity.

However, it is possible that the pilot was encouraged by a perceived improvement to the weather on the Isle of Wight and by the 1350 hrs weather report at Southampton where visibility was 8 km, the lowest cloud was at 1,200 ft agl and the main base was at 2,300 ft agl. He may also have noted that airfields near his destination had cloud below 500 ft agl at 1350 hrs but forecast good visibility and no cloud below 1,200 ft agl around his estimated time of arrival.

It was not possible to confirm whether the pilot viewed all the available weather information. If he did not, he may not have appreciated the difficulties there could be in navigating this route while maintaining safe terrain clearance, due to the limited visibility and low cloud. It is also possible, because he possessed an IMC rating, that he was content to fly in weather conditions close to the VFR minima. His aircraft was not certified to fly with sole reference to instruments but he may have felt confident to use the instruments to assist him in poor conditions without a clear horizon.

The freezing level was above 4,000 ft near Gatwick, after the front had passed, so there is no evidence that the aircraft might have been affected by airframe icing.

Departure and initial part of the flight

Based on the limited recorded data, the pilot apparently back-tracked the route taken to Bembridge the previous day but at a slower speed. Before reaching the mainland coast, the transponder and radio settings indicated that the pilot was listening to the Southampton ATC frequency. At no point in the flight was transponder altitude reporting (Mode C) active and no radio calls were received from the aircraft. There was no requirement for the pilot to contact ATC while in Class G airspace.

The Mode A transponder returns ceased in the vicinity of Portsmouth Harbour; later examination of the transponder identified that it was in standby mode and no evidence of a technical fault was found that would have prevented radio communication or transponder Mode A reporting.

In the absence of evidence of a technical fault, it is likely that the pilot set the transponder to standby. This could have been because he had encountered worse weather conditions than anticipated and did not wish to be distracted by ATC while trying to fly and navigate the aircraft clear of cloud. The aircraft's position at this time coincided with the Met Office's assessment of where the band of rain and cloud associated with the weather front was likely to have been. Data from the TCU indicated that it was around this time that the aircraft stopped climbing at about 1,600 ft amsl and started to descend. A diversion or return at this point might have been appropriate. After this, the aircraft altitude varied between 800 ft and 1,300 ft amsl.

Diversion to Popham

The recorded data shows that, approximately 19 minutes after takeoff, the aircraft was climbing through 2,000 ft as the TCU stopped recording. It is not clear why the climb was initiated.

The damage to the wire from the throttle position sensor to the TCU is consistent with it having chafed on an adjacent part of the engine. This would have created a ground on the wire, causing the TCU to drive the wastegate of the turbo fully closed and trigger the orange flashing TCU warning light on the instrument panel. It is also likely that engine manifold pressure and rpm would have increased in response to the turbo becoming active, although with the throttle below the takeoff power position, it is unlikely the engine would have exceeded any operating limitations at this point.

Given the warning notice in the engine Operator's Manual and his familiarisation training, it is likely the pilot's response was to isolate the electrical power to the TCU by pulling the circuit breaker. This would have frozen the servo valve and thus the turbo wastegate in the fully closed position. It would also have prevented the overspeed protection logic and the orange and red warning lights from working, and would have stopped the TCU from recording. In this sequence of events the fault, fault indication and the subsequent electrical isolation of the TCU must have occurred before the next 60 second period of data gathering and recording could be completed.

The pilot may have diverted to Popham to minimise the flight time with a turbo fault or it may have been because the weather was too poor to continue. Popham was near the planned route, he had passed it on the flight south and he was likely to have had it displayed on the navigation app on his tablet. The subsequent descent and track, recorded on radar, are consistent with this. The lack of any radio call to Southampton or to Popham and the fact that the Popham frequency had not been selected, suggest the pilot was fully occupied as he dealt with poor weather, a malfunctioning turbo and diverting to an unfamiliar airfield.

Arrival at Popham

The wind at Popham was reported to favour a landing on Runway 03. It is not clear whether the pilot tried to make a straight-in approach to Runway 26 at Popham and then went around or whether he overflew the airfield before deciding on which runway to land. Witness evidence suggested that the aircraft flew a low-level circuit which ended up on what appeared to be a base leg for Runway 03. However, it is equally possible that the pilot's intention was to position downwind, at low level, for Runway 26. The landing gear was selected down, which indicated an intention to land but evidence from the wreckage indicated that the flaps were retracted when the aircraft crashed.

Power increase

The normal landing configuration for this aircraft type involves the use of full flaps, so at least one stage of flap is likely to be selected when late downwind or on base leg. During the evaluation flight it was noted that the aircraft's performance was poor with gear down and full flap selected.

With the turbo wastegate fully closed, the pilot would have had to limit the throttle position to keep the engine parameters within limits. With the TCU not powered, the only additional warning of an engine exceedence was the rpm display on the EIS turning yellow and then red. However, this display was very small and the pilot may have overlooked it when he was preparing to land at an unfamiliar airfield in poor weather. If the pilot conducted a go-around from an approach to Runway 26, he managed to do so without causing a catastrophic engine exceedence.

However, during the subsequent circuit, when heading east, the engine stopped and the aircraft stalled into trees. It was not possible to determine whether the pilot inadvertently selected too high a throttle position, was unaware of the potential consequences of depowering the TCU or he had no alternative in order to try to maintain airspeed and altitude. However, with the TCU protection logic disabled, there was no limit on the manifold pressure produced by the turbo until it reached its maximum performance. The engine manufacturer confirmed that excessive manifold air pressure could result in misalignment of the engine crankshaft to an extent that the engine would seize. The evidence from the engine strip and the location and lack of damage to the propeller blades, support the conclusion that the engine stopped in-flight for this reason. One witness noticed the engine noise reduce before the aircraft was lost from view.

The stall

The pilot apparently warned the passengers to brace thus indicating that he was conscious immediately before the accident and aware that the aircraft was about to crash. With no engine power available, it is possible that the pilot retracted any flap that had already been extended in an effort to extend the glide and clear the trees. Retracting the flap would have reduced the drag but it would have increased the stall speed and the evidence from the car driver suggests that the aircraft stalled before it struck the trees.

Differences training

Prior to 3 January 2015, the pilot had logged fewer than five flying hours on type, but he had previously flown for 35 hours in the smaller two-seat version of the aircraft. He indicated when he purchased G-CGVO that he had completed appropriate differences training but there is no written record of this being the case. However, he did have experience with a retractable undercarriage and a variable pitch propeller while flying his previous aircraft, so his apparent lack of differences training on these systems is unlikely to be relevant to the accident.

The test pilot who carried out the evaluation flight reported that, in normal circumstances, the turbo on this aircraft did not present a pilot with any special challenges. However this aircraft apparently suffered an unusual turbo malfunction and the pilot would have needed detailed knowledge of this aircraft's specific installation to cope with it. The differences training, required by regulation, could have been achieved on another SEP Class '*variant*' without covering the technical detail specific to this engine installation. Although the pilot had not apparently received formal differences training for turbochargers, he had received familiarisation training specific to this '*variant*' from the individual who had sold him the aircraft.

Aircraft Flight Manual – TCU warnings

The Aircraft Flight Manual has no guidance on the actions to be taken if the orange caution light for the TCU illuminates. The pilot may have been aware of the statement in the engine Operator's Manual which intimates that the servo motor for the wastegate should be turned off. However, the wording is ambiguous and given the specific configuration on this aircraft, it results in removing power from both the TCU and the servo motor. If the pilot did this, by pulling the circuit breaker, there would have been several implications. Firstly, it would have frozen the wastegate in its current position (in this case the ground on the chafed wire would have run it to the fully closed position), even if the ground had been intermittent and the problem was temporary. Secondly, it disabled the manifold pressure exceedence protection, although the ground on the wire would also have had this effect. Thirdly, and perhaps most significantly, it disabled the manifold pressure exceedence red warning light. This information was not provided in any of the operating manuals in a readily accessible way and the pilot may not have been aware of these issues. As a consequence the following Safety Recommendations are made:

Safety Recommendation 2016-027

It is recommended that Alpi Aviation modify the design of the Pioneer 400 to ensure that the manifold pressure exceedence red warning light remains functional, by allowing isolation of electrical power to the turbo wastegate servo control motor without removing power from the Turbo Control Unit.

Safety Recommendation 2016-028

It is recommended that BRP-Powertrain GmbH & Co. KG amends the Rotax 914 engine Operator's Manual, to clarify the actions required by the pilot following activation of the orange Turbo Control Unit warning light, particularly with regard to isolation of the turbo wastegate servo control motor.

Safety Recommendation 2016-029

It is recommended that Alpi Aviation incorporate in the Pioneer 400 aircraft operating manual, the manifold air pressure limits and warnings, and pilot actions described in the Rotax 914 engine Operator's Manual, for red and/or orange Turbo Control Unit warning light activation.

In light of the chafing damage identified on the engine wiring, the following Safety Recommendation is made:

Safety Recommendation 2016-030

It is recommended that BRP-Powertrain GmbH & Co. KG reviews the wiring installation design and guidance for the Rotax 914 engine to optimise the routing and protection for wiring looms to minimise the likelihood of damage from chafing.

Light Aircraft Association review

As a consequence of the issues identified by this investigation, the LAA have advised that they intend to conduct reviews into differences training requirements for pilots operating aircraft with turbocharged engines, and also the minimum requirements for instrumentation and the wastegate control system for this type of engine.

Conclusion

When the pilot reached the mainland coast it was likely that he saw a deterioration in the weather that eroded the safety margins for VFR flight. At this early stage, it would have been prudent to divert to a suitable nearby airfield or to have turned back to Bembridge. Safety Sense leaflet 1e *'Good Airmanship'* advises pilots how to plan VFR flights around the forecast weather and on decision making when the conditions encountered are worse than anticipated.

Whilst a very specific defect occurred on this aircraft, the engine was still capable of being operated safely with an increased level of pilot monitoring and awareness. The engine most likely only stopped as a result of the throttle being moved by the pilot to a setting where a damaging level of manifold pressure was reached. Regardless of this, pilots with an SEP Class rating are trained in the need to anticipate engine failures for any reason and to conduct forced landings when necessary.

The poor weather conditions at Popham meant the pilot, who had limited flying experience, especially on this aircraft type, had to fly below the normal circuit height. This would have increased his workload and reduced the time available in which to make critical decisions. When combined with the additional workload created by the engine fault, this may have led to the circumstances surrounding the failure of the engine and would then have limited the options available when confronted with the need to perform a forced landing.

Bulletin Correction

Two corrections were issued regarding this report on 9 June 2016.

Under Meteorological information, the report stated that the 'Met Office aftercast agreed with the forecast chart (F215) for weather below 1,000 ft between 0800 hrs and 1700 hrs.' The report should have stated '…weather below **10,000 ft**…'

Additionally, the file reference quoted on the page header for this report was incorrect and should have read '**EW/C2015/01/02**' not 'EW/C2015/01/02/02 as originally shown.